GRAINS FOR WESTERN NORTH AND SOUTH DAKOTA

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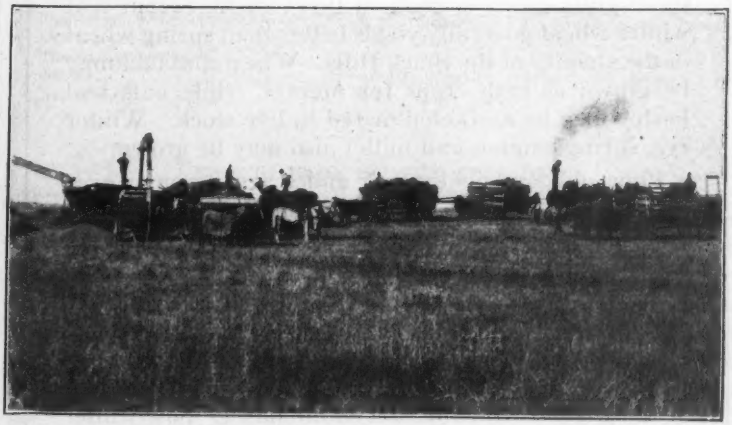

FARMERS' BULLETIN 878
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

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XUM

THE PRODUCTION of the small grains in western North and South Dakota and eastern Montana is most profitable when combined with live-stock farming and the growing of cultivated crops.

Spring wheat, oats, barley, and flax are the best small-grain crops to grow in this section, except that winter wheat generally yields better than spring wheat in the vicinity of the Black Hills. Wheat and flax may be grown as cash crops for market, while oats and barley may be marketed or fed to live stock. Winter rye, spring emmer, and millet also may be grown.

Plow old land in the fall and leave it rough over winter or plow it in the spring. Fall plowing, however, permits earlier seeding in the spring. Land on which a cultivated crop was grown the previous year need not be plowed. Prepare a good seed bed in spring with the disk and spike-tooth harrows.

Sow spring wheat and oats as early as the land can be put in good condition, barley after wheat and oat seeding is finished, and flax about May 1. Sow winter wheat and winter rye in late August or early September in North Dakota, and in September or early October in South Dakota. Sow on corn stubble or summer-fallowed land.

The best rates of seeding are as follows: Spring wheat, 4 pecks per acre; winter wheat, 3 to 4 pecks per acre, oats and barley, 5 to 6 pecks per acre, and flax, 20 to 30 pounds per acre. The best varieties to grow are named on page 21.

GRAINS FOR WESTERN NORTH AND SOUTH DAKOTA.

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DESCRIPTION OF THE SECTION.

THIS bulletin gives information regarding the best grains and the best methods of producing them in the western half of North and South Dakota (west of the one-hundredth meridian) and in the eastern fourth of Montana. The information is based largely on experiments conducted during the last 9 or 10 years at three stations—Williston and Dickinson, N. Dak., and Newell, S. Dak. (See fig. 1.) The crops considered are wheat, rye, emmer, spelt, oats, barley, flax, and proso millet.

TOPOGRAPHY.

The area north and east of the Missouri River varies from comparatively level land to sharply rolling hills of glacial origin. West of the Missouri River are gently rolling hills and flat-topped buttes, with small valleys between. A few districts, such as the Bad Lands along the Little Missouri River in western North Dakota and the Black Hills in extreme western South Dakota, are too rough for tillage but are adapted to ranching. Williston is 1,875 feet above sea level; Dickinson, 2,453 feet; and Newell, 2,900 feet. Figures 2 and 3 show views of the experimental plats at Dickinson and Williston and give a fairly good idea of the topography.

SOILS.

The soils of the entire section are fairly deep and are generally well supplied with plant food. In western North Dakota fine sandy loam is the prevailing type, clay in eastern Montana, and clay loam

and gumbo in South Dakota. A large district of gumbo soil surrounds the Black Hills in South Dakota and extends east to the Missouri River.

CLIMATE.

Rainfall generally decreases to the westward in this area, while the temperature and evaporation gradually increase from the Canadian line southward.

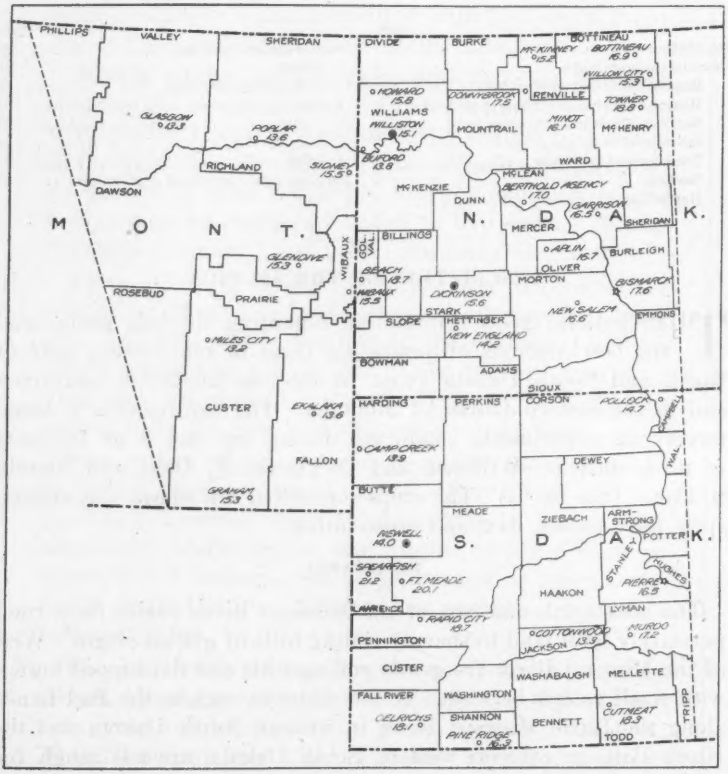

FIG. 1.—Map of western North and South Dakota and eastern Montana, the section to which this bulletin applies. The locations of the experiment farms at Williston and Dickinson, N. Dak., and Newell, S. Dak., are shown, with the rainfall at these points and at a number of others in the States named. The rainfall figures are averages for periods of varying length, most of them being for more than 10 years. These data are from the records of the Weather Bureau.

Rainfall.—The annual rainfall varies in general from 13 to 19 inches, though it reaches 21 inches in the Black Hills. The average rainfall of the different stations shown on the map (fig. 1) is about 16 inches.

More than half of the annual precipitation occurs during the four growing months of April, May, June, and July. The rainfall usually is sufficient to insure fair to good crops of grain. In occasional dry years the grain crop is a partial or complete failure, especially in western South Dakota.

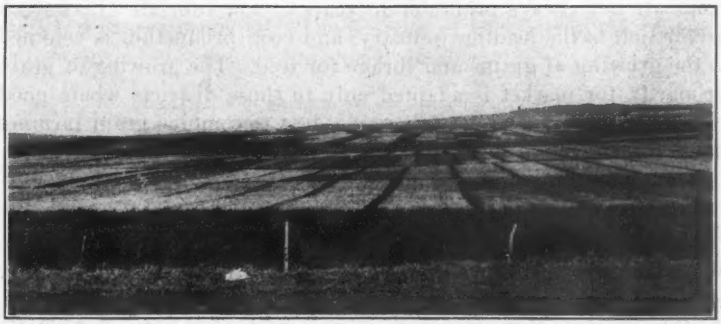

FIG. 2.—General view of the varietal plats of cereals at the Dickinson substation.

Evaporation.—In this section the evaporation is less than in the central and southern portions of the Great Plains area; hence less rain is required to produce a crop.

Temperature.—The mean annual temperature at both Williston and Dickinson is about 40° F. At Newell it is 44° F. The average frost-free periods at the three stations in the nine years from 1908

FIG. 3.—General view of the varietal plats of cereals at the Williston substation.

to 1916 are 108 days at Williston, 101 days at Dickinson, and 125 days at Newell. At Williston the average frost-free period for 35 years has been 119 days; at Dickinson, 109 days for 25 years.

The growing season is long enough to insure good crops of spring grain. The winters usually are too severe for winter wheat in North Dakota and eastern Montana, but winter rye may be grown successfully. In districts near the Black Hills in western South Dakota winter wheat usually is successful.

FARMING CONDITIONS.

Most of the section discussed in this bulletin can not be irrigated; and, as the rainfall is comparatively low, dry-farming methods are practiced. Profitable crops of grain are usually grown in most of the section, but in the drier portions of western South Dakota grain crops are not always profitable in years of low rainfall. Live-stock production is the leading industry, and crop production is confined to the growing of grains and forage for feed. The growing of grain primarily for market is adapted only to those districts where good yields are assured, and even there it is best to combine grain farming with the production of live stock.

CROPS GROWN.

The leading crops are wheat, oats, barley, flax, rye, corn, alfalfa, and other forage crops. New settlers with little capital and few live stock usually raise wheat and flax, for which there is a ready market. As they increase their live stock, more oats, barley, corn, and alfalfa are needed.

DIVERSIFIED FARMING.

Only the small-grain crops are discussed in this bulletin. It is to be understood, however, that grain farming alone is not permanently profitable. It is better to combine live-stock production with it, growing corn, alfalfa, and other forage crops for feeding. Corn does well after small grain, and small grains do well after corn. The small grains also succeed after alfalfa and other forage crops, though it is best to grow a cultivated crop after alfalfa before sowing the small grains. Whatever system of farming is practiced, the grain crops have an important place in the crop rotation.

GROWING THE GRAIN CROPS.

The directions here given for growing grain crops are general, with modifications for differences in soil and climate. Owing to local variations these directions may not apply to all districts.

MAKING A SEED BED ON BREAKING.

The best time to break the native sod is in April, May, or June, because the soil usually is moist at that time. Late May or early June is considered best, as the grass then is young and succulent and decays readily. Later the sod may be dry, breaking with difficulty and decaying more slowly. Sod usually should be broken 4 or 5 inches deep. If the grass is thin and the sod light, deeper breaking is possible, especially with an engine. Pack the breaking with a roller or disk the day it is plowed, if possible. This closes up large air

spaces and lessens the drying of the soil. Follow the roller immediately with the disk harrow and also with a spike-tooth harrow if spring grain is to be sown. Fresh breaking works up easily, but if not disked for a few days it dries rapidly, greatly increasing the work necessary to prepare a good seed bed.

If spring grain is to be grown on breaking, sow as soon as a good seed bed can be prepared. The practice of backsetting the breaking before sowing a crop usually is not profitable.

MAKING A SEED BED ON STUBBLE OR OLD LAND.

Old or stubble land should be plowed in the fall or early spring. Fall plowing is better than spring plowing, because it permits early seeding. So much better results are obtained from early than from late spring seeding that generally it is advisable to do as much fall plowing as possible. Sandy soils with a tendency to drift, as in the New Salem district of North Dakota, should be plowed only in the spring.

When land is fall plowed it should be left rough, to catch and hold the snow and to prevent soil blowing. Plow 6 to 8 inches deep if possible, covering all weeds and trash. Spring plowing may be slightly shallower than fall plowing. It should be worked immediately with the disk and spike-tooth harrows.

A good seed bed is firm underneath with 2 or 3 inches of loose soil on top. The surface mulch should not be too fine and powdery, as blowing may result in some districts or rains may puddle it and then will not penetrate so readily. An excellent seed bed can be made in the spring on fall plowing or on spring plowing with the diately with the disk and spike-tooth harrows.

SUMMER FALLOW AND CULTIVATED CROPS.

Settlers in some sections practice summer fallowing to destroy weeds and hold soil moisture. On older farms, where more live stock is raised, corn usually is grown for feeding. The disked corn stubble is an excellent substitute for fallow as a preparation for spring grain. Fallow land produces no crop the year that it is fallowed, while if planted to corn from 2 to 4 tons of corn fodder to the acre may be grown, and in some years good yields of mature grain may be obtained. The corn crop requires but little more labor than the fallow. The small grains yield almost as well after corn as after fallow. Potatoes and other cultivated crops also are good substitutes for fallow in preparing the ground for small grain.

Where winter wheat is grown extensively, some fallowing may be advisable. One year of fallow and two or three years of cropping usually will be more profitable than alternate cropping and fallow-

ing. In general, however, the increased production of live stock is recommended, with the growing of considerable corn and the use of disked corn stubble instead of fallow for spring grain.

Whenever summer fallowing seems necessary the ground should be plowed soon after the weeds start to grow, usually in June. Plowing may also be done in May or in the fall if other farm work permits. If it is not done till July, the weeds will have used much moisture. Plow the ground to a good depth. When the weeds start to grow again, cultivate with the spring-tooth disk or harrow often enough to keep them in check. Keep the weeds down, but do not pulverize the soil too finely.

In the Pacific Northwest, where fallowing has long been practiced, several forms of bar or knife weeders have been devised. These weeders probably can be used to advantage in controlling weeds on fallow in the Dakotas and Montana. The following discussion of weeders for fallow is from a recent bulletin on dry farming in southern Idaho.[1]

The spike-tooth and disk harrows are effective weeders, but there are times when they can not and should not be used. The spike-tooth harrow is effective when the weeds are very small. The disk harrow is effective when the weeds are so well rooted that no other tool will kill them. Disking, however, is expensive and often pulverizes the soil more than is desirable. Various weeders, homemade and manufactured, are now in use. Many of them are cheap, effective, easily operated, and will cover a large acreage in a day.

The "slicker," or knife weeder, is a tool 6 to 12 feet in length. One of the simpler forms is made by nailing boards or planks on top of three or four 2-inch by 8-inch sled runners 3 feet long, with a blade bolted under the middle or the rear end of the runners. This blade is made of a 3-inch iron bar half an inch in thickness and sharpened on the front edge. In the bar weeder, a round five-eighths-inch or three-fourths-inch rod is used instead of a blade. A 6-foot running board is nailed across the top in the middle of the machine and extends to the rear. The driver stands on this board and regulates the dip of the knife or bar by shifting his weight forward or backward. The blade is cleaned by lifting the rear end of the machine. The blade of the slicker should be made of the best steel and kept sharp.

SELECTION OF SEED.

It is advisable to sow good seed of varieties recommended by the nearest experiment station. After seed of a good variety has been obtained it pays to grow one's own seed. Home-grown seed, if of fair quality, is better than that obtained from a distance. Each farmer will do well to keep his seed as pure as possible and to select for seed a field that can be kept free from weeds and grain mixtures. If good seed is not available at home or in the locality, the nearest experiment station usually can supply it or tell where it can be ob-

[1] Aicher, L. C. Growing grain on southern Idaho dry farms. U. S. Dept. Agr., Farmers' Bul. 769, p. 9. 1916.

tained. Seed grain should be well cleaned by screening and blowing out light and diseased kernels and weed seed. It is much easier to remove weed seeds from seed grain than to destroy weeds in the field.

TREATING SEED FOR DISEASE.

The more common cereal diseases in western North and South Dakota and eastern Montana are rust and smut. Rust can not be prevented by seed treatment. Damage from rust can be partially avoided by early seeding, using early varieties or varieties that are somewhat rust resistant.

The covered smut of wheat and barley and the loose smut of oats can be fairly well controlled by the formaldehyde treatment, as follows:

Blow out with a fanning mill as many of the smut balls as possible, or remove them from the grain by other means. Mix 1 pound of common commercial formaldehyde with 45 gallons of water. Sprinkle the mixture over the grain spread several inches thick on a clean floor or canvas, stirring till every kernel is thoroughly wet. Cover the grain with a blanket for several hours, then spread it out to dry, stirring if necessary. If the smut balls are not removed before treating with the formaldehyde solution they may break later and again infect the seed, as they are not penetrated by the solution.

The grain may also be treated in sacks, putting about a bushel in each. Tie the sacks at the top, leaving room for the grain to swell. Put them into a barrel containing the solution, leaving the grain to soak about 10 minutes. It should then be taken out and dried. If the sacks are placed where the wind strikes them the grain may be dried in them. It must not be allowed to freeze while wet.

It is important to have the formaldehyde solution of the proper strength. If too strong it will delay or lessen the germination of the seed. If too weak it will not kill the smut spores. Before the seed is sown the drill should be washed out with the solution, to destroy any smut spores in it.[1]

SEEDING.

Rates and dates of seeding for each crop are discussed in the pages which follow. In general, spring grain should be sown as early in spring as the land can be put in good condition. Drilling is to be preferred to broadcast seeding, for drilled grain almost always yields better. The seed usually should be sown about 2 or 3 inches deep. The important thing is to get it into soil sufficiently moist to insure germination.

HARVESTING.

Most of the grain in western North and South Dakota and eastern Montana is cut with the binder and thrashed from the shock. Shock

[1] For a complete discussion of grain smuts and their treatment, see Johnson, E. C., The smuts of wheat, oats, barley, and corn. U. S. Dept. Agr., Farmers' Bul. 507, 32 p., 11 fig. 1912.

thrashing requires less labor than stacking and thrashing and is satisfactory when a thrashing machine can be obtained soon after harvest. If one has to wait long for a thrashing machine, the grain should be stacked. Stacking prevents injury from fall rains and clears the land for fall plowing. In addition the grain may be improved in quality by passing through the sweat in the stack.

Both the shocking and stacking of grain should be done carefully, to avoid injury from winds and wet weather.[1]

GRAIN CROPS AND VARIETIES.

WHEAT.

Wheat is the most important crop in the northern Great Plains. Spring wheat is commonly grown in the section here discussed, but winter wheat is important in the immediate vicinity of the Black Hills in South Dakota.

SPRING WHEAT.

The production of spring wheat in western North Dakota and eastern Montana is favored by climatic conditions and by the ready cash market for the crop. North Dakota alone produced over 150,000,000 bushels of spring wheat in 1915. It yields best in a rotation with corn and forage crops. With the increase of live stock and diversified farming in western North Dakota and eastern Montana spring wheat will continue to be the leading cash crop.

Spring wheat is grown also in western South Dakota, but in the drier localities the yields have not been sufficient to make it profitable. Spring wheat ripens later than winter wheat; hence it is more likely to be injured by rust and drought. Where winter wheat survives the winter in the vicinity of the Black Hills in South Dakota, it yields more than spring wheat.

The spring-wheat varieties adapted to western North and South Dakota and eastern Montana are all hard wheats. The two main divisions of hard spring wheat are the common and the durum.[2] The common wheats have rather long, slender heads, which may be either bearded or beardless. The durum (macaroni) wheats have broad, bearded heads with large, very hard kernels. The leading groups of spring common wheat are the Fife, Bluestem, and Preston (Velvet Chaff). Heads of representative varieties of these groups and of Turkey, the leading winter variety, are shown in figure 4.

[1] For a more complete discussion of shocking and stacking grain, see Ball, C. R., and Clark, J. A., Growing hard spring wheat, U. S. Dept. Agr., Farmers' Bul. 678, 16 p., 4 fig. 1915.

[2] For a more complete discussion of spring wheat varieties, see Ball, C. R., and Clark, J. A., Varieties of hard spring wheat, U. S. Dept. Agr., Farmers' Bul. 680, 20 p., 7 fig. 1915.

The durum wheats are more rust resistant and usually more drought resistant than the common wheats. Occasionally, when hot, dry winds occur at blossoming time, the heads of durum wheat have failed to fill properly in some localities. When rust epidemics are severe, durum wheat usually produces fair yields, while common wheats often fail. The durums are more likely to lodge than the common wheats and for this reason sometimes require more labor in harvesting and thrashing. On the other hand, the durums do not shatter readily. Until recent years the market price of durum wheat was considerably below that of spring common wheat, but since 1912 the difference has been slight, the price of durum often being higher than that of similar grades of spring common wheat.

The relative yields of the leading varieties of each of the important groups of wheat at the Williston, Dickinson, and Belle Fourche

FIG. 4.—Representative heads of different types of wheat: 1, Turkey winter; 2, Fife; 3, Preston; 4, Bluestem; 5, durum.

(Newell, S. Dak.) stations are shown graphically in figure 5. In each case the yields are shown in percentages of the yield of the best durum wheat in the same period of years.

At the Belle Fourche Experiment Farm during the nine years from 1908 to 1916, inclusive, the average yield of the best variety of durum wheat has been 2.5 bushels more than that of the best variety of spring common wheat. At Dickinson, N. Dak., the 10-year average yield is about 6 bushels in favor of the durum, while at Williston the durums have yielded somewhat more than the common wheats. The higher yields of durum in most of the section here discussed will offset a considerable difference in price. Because of the higher yields of durum wheats and their greater resistance to rust and drought, they should be more extensively grown in all parts of this section where spring wheat succeeds.

Of all the durum varieties tested at the three stations, the Kubanka, introduced into the United States from Russia in 1899 by Mr. M. A. Carleton, cereallist of the United States Department of Agriculture, has yielded best. It is recommended to all who wish to grow durum wheat in this section.

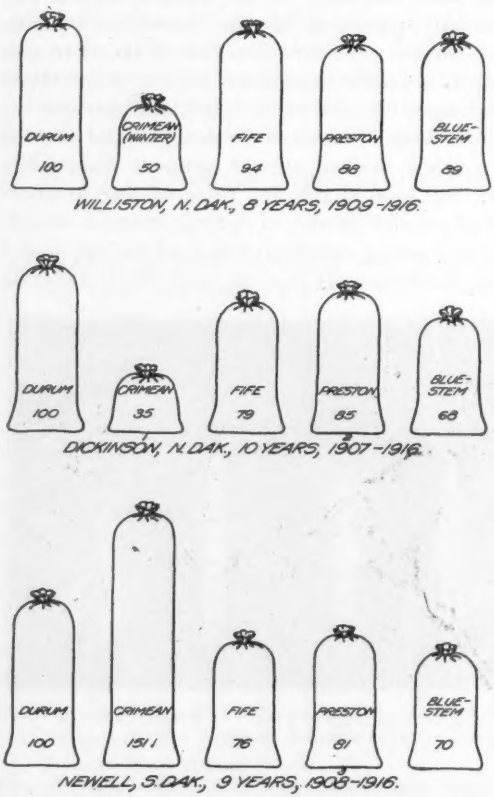

FIG. 5.—Average yields of the leading varieties of the principal groups of wheat grown on the three experiment farms at Williston and Dickinson, N. Dak., and Newell, S. Dak. The figures are percentages of the yield of Kubanka durum wheat, at each station. Figures from Williston are for 8 years, Dickinson 10 years, and Newell 9 years, except that (1) those for Crimean at Dickinson are for 4 years, (2) those for Preston at Dickinson are for 6 years, and (3) those for Preston at Newell are for 7 years.

The Fife varieties of common wheat have yielded well in the section discussed in this bulletin. The Marquis has proved to be the best variety of Fife wheat for most of the section. It has been tested four years at all three stations. During that time it has been the highest yielding spring common wheat at Newell and Dickinson, and highest of all except Power Fife at Williston. The difference in yield between the Power Fife and Marquis at Williston is slight. The Marquis wheat was originated by the Canadian Department of Agriculture. It is similar in appearance to the other Fife varieties, but the straw, heads, and kernels are all shorter than those of typical Fife wheat, and it ripens several days earlier. Its earliness enables it to escape to some extent the effects of drought and rust. The short, stiff straw is not likely to lodge. The grain is held firmly by the chaff, so that it does not shatter readily, but on the other hand it

thrashes with some difficulty. On farms in the vicinity of Williston the Marquis has sometimes been too short to harvest easily when sown on land cropped to small grain the previous year. In that district the Power Fife, which has longer straw, has given good results. In districts where the rust epidemic of 1916 was severe the Marquis yielded more than any other variety of Fife wheat.[1] The Marquis wheat is especially recommended for sowing on corn stubble, fallow, or rich land where other varieties are likely to lodge.

The Preston (Velvet Chaff) wheat is a bearded spring wheat, yielding less than the Marquis in most of the section under discussion. It is also of poorer milling quality.

Varieties of the Bluestem group usually yield less than the Fife wheats in this section. They shatter readily, and their lateness makes them more subject to injury by drought, rust, and frost. The Preston and Bluestem wheats are not recommended for western North and South Dakota and eastern Montana.

Early seeding of spring wheat is best. It should be sown as early as a good seed bed can be prepared. Late-sown grain is more likely to be injured by drought, rust, frost, and hail.

One bushel per acre is about the best rate at which to sow spring wheat, as shown by experiments at the three stations and the experience of farmers. In the drier sections or in very dry seasons thinner seeding may give slightly better results. Durum wheat has larger kernels and tillers less than common wheat; hence, usually it is sown at the rate of about 5 pecks per acre.

Spring wheat usually should be sown from 2 to 3 inches deep, to get it in moist soil. In heavy, wet soil, covering the seed from 1 to 2 inches will be sufficient.

WINTER WHEAT.

Where winter wheat is known to survice, as in the vicinity of the Black Hills and in a few other small districts in western South Dakota and southeastern Montana, it is more productive than spring wheat in most years. Winter wheat ripens earlier than spring wheat and is thus more likely to escape injury from drought and rust. At the Belle Fourche Experiment Farm, near Newell, S. Dak., the average yield of winter wheat in a period of nine years is 8 bushels per acre higher than the average yield of the best variety of spring wheat during the same years. In fact, winter wheat is perhaps the only grain crop which can be grown at a profit in the drier portions of

[1] For a more complete description of Marquis and other spring wheat varieties, see the following:

Ball, C. R., and Clark, J. A. Marquis wheat. U. S. Dept. Agr., Farmers' Bul. 732, 7 p., 2 fig. 1916.

——— ——— Varieties of hard spring wheat. U. S. Dept. Agr., Farmers' Bul. 680, 20 p., 7 fig. 1915.

western South Dakota. Outside of the Black Hills district of South Dakota, especially in North Dakota, winter wheat is winterkilled except during unusually mild winters or unless it is protected. The only successful method of growing winter wheat in these sections is by seeding in cornstalks or stubble which hold the snow and thus protect the wheat considerably. Even then winterkilling often is severe. At Dickinson, N. Dak., during the four years from 1913 to 1916, inclusive, the best spring wheat yielded 8.4 bushels more per acre annually than the best winter wheat. The winter wheat was protected by standing cornstalks. The acreage of winter wheat is increasing in western North Dakota, but because of the uncertainty of winter survival it can not be recommended there.

FIG. 6.—Plat of winter wheat on the Belle Fourche Experiment Farm, Newell, S. Dak., in 1915.

At Newell, S. Dak., winter wheat yielded best on fallowed land. A plat of winter wheat on fallow at Newell is shown in figure 6. The Kharkof winter wheat has averaged nearly 26 bushels per acre on fallow during the last nine years, which include two years of complete failure on account of drought. Good yields of winter wheat may be expected also when sown on corn ground. If winter wheat is badly winterkilled there is still an opportunity to sow some spring crop on the land, with no loss except the expense of seeding the winter wheat.

Tests of varieties of winter wheat have been conducted since 1908 on the Belle Fourche Experiment Farm at Newell, S. Dak. The Kharkof variety has yielded best during this period, though the

average yield of the Turkey is only slightly lower. These varieties belong to the Crimean group of hard red winter wheat and are practically identical in appearance. The Kharkof wheat was imported by the United States Department of Agriculture from Kharkof, Russia, in 1900. The Turkey variety was first brought to this country from Crimea, in southern Russia, by the Mennonites in 1873. Little or no difference is apparent in either the yields or winter hardiness of these two varieties of winter wheat, and either of them may be grown. The beardless winter-wheat varieties have not yielded as well at Newell as the bearded varieties of the Crimean group.

The proper time to sow winter wheat varies from year to year. Experiments at Newell indicate that winter wheat should be sown before October 15. Seeding in September is usually safest. Late seeding of winter wheat is not recommended, although fair yields have been obtained from winter wheat which was sown in November and did not come up until April. Seeding before September 15 usually does not result in higher yields than seeding in early October. If the wheat plant reaches the second leaf stage it may survive the winter as well as if it had produced six or eight tillers. On fallowed land or corn ground it is advisable to sow winter wheat not later than October 1, even though the soil is dry. Except in 1911, the rainfall has been sufficient to bring up winter wheat in the fall each year since experiments were begun at Newell in 1907. Wheat comes up more quickly if sown before the fall rains than if seeded immediately after them. Land from which a crop has been harvested recently is often too dry to start the wheat in the fall. In North Dakota and eastern Montana it should be sown during the latter half of August or early in September.

Winter wheat should be seeded deep enough to get it into moist soil. The proper depth is about 2 or 3 inches, and seeding deeper than this is not advisable. If winter wheat is seeded too shallow, the surface soil may dry out before the seeds have sprouted.

Experiments at Newell show that winter wheat should be sown at the rate of 3 or 4 pecks per acre. If the seeding is late or the land is poorly prepared, 4 pecks per acre should be sown, but on fallowed land 3 pecks is enough, especially if the wheat is sown early. Seeding less than 3 pecks per acre has resulted in lower yields. The rate of seeding should be heavier than usual if the grains are swollen from the smut treatment or if the kernels are unusually large.

RYE, EMMER, AND SPELT.

RYE.

The acreage of winter rye in western North and South Dakota has increased rapidly during the last few years. Winter rye is much hardier than winter wheat. The hardy varieties of winter rye seldom

winterkill when unprotected even in northern North Dakota. At Newell, S. Dak., winter rye has yielded less than winter wheat, but in North Dakota it has yielded considerably more. It is a valuable feed crop and there is also some demand for it on the market.

If sown early, winter rye may be pastured to some extent in the fall, and the vigorous growth in early spring supplies some spring pasturage. It is often used as a smother crop to keep weeds in check. It ripens earlier than any other grain crop in this section, which usually enables it to escape serious injury from drought. It also ripens earlier than wild oats, making it a desirable crop to grow on land infested with this and other noxious weeds. Much land in the Dakotas has become foul with wild oats through continuous grain growing, and winter rye is being used more and more as a crop to help rid the land of this pest.

In North Dakota and Montana the variety of winter rye known as North Dakota No. 959 should be grown. In western South Dakota either this variety or Swedish (Minnesota No. 2) is suitable. Spring rye is not widely grown in western North and South Dakota and does not yield as well as winter rye.

In western North Dakota and eastern Montana winter rye may be sown from August 15 to September 15. In South Dakota it should be sown not later than October 15. Early seeding is preferred, especially if it is desired to rid the land of weeds. When sown early the plants tiller more and less seed is required per acre. From 4 to 5 pecks per acre is the usual rate of seeding.

Winter rye is often sown in disked grain stubble, thus requiring little labor in preparing the soil. When stubble ground is too dry for the seed to germinate, it may be sown on corn land, on fallow, or on fall plowing.

EMMER AND SPELT.

Spring emmer, commonly but incorrectly called spelt or speltz, is grown to some extent as a feed crop in western North and South Dakota. The Yaroslav is the best variety of spring emmer for this region. Its yield in pounds per acre is about the same as that of oats or barley,[1] and its feeding value is about the same as that of oats. The Yaroslav emmer is fairly drought resistant and very rust resistant. Winter emmer is not hardy enough for the Dakotas.

Spring emmer should be sown early at the rate of about 6 pecks per acre.

[1] At Williston, in an 8-year test, Yaroslav emmer yielded a little less in pounds per acre than the best varieties of oats and barley, while at Dickinson, in the same period, it yielded slightly more. At Newell the average yield of emmer is much lower than that of the best varieties of oats and barley.

OATS.

Oats can be recommended as a profitable feed crop for the northern Great Plains. Very satisfactory yields have been obtained in western North Dakota and eastern Montana. At the Belle Fourche Experiment Farm at Newell, S. Dak., oats have not yielded as much as wheat. In the drier portions of western South Dakota oats have not been profitable in years of low rainfall, and this crop is not recommended for growing there for market. It may continue to be grown to some extent for feed, however.

Drilling on disked corn ground is the best method of seeding oats.

The early yellow varieties, Sixty-Day and Kherson, have yielded best at Newell, S. Dak., and on dry land in Montana. The midseason

FIG. 7.—Heads of four varieties of oats grown at the Dickinson substation: From left to right—(1) Early Mountain, (2) Victory, (3) Kherson, and (4) White Russian.

white varieties have yielded best in western North Dakota. At Williston, the Abundance, Lincoln, and Early Mountain have yielded considerably more than the early varieties, ranking in the order named. At Dickinson, the Early Mountain, Abundance, Golden Rain,[1] and Victory have yielded a little more than the Kherson and Sixty-Day. The late varieties of side oats have not yielded well at any of the stations. The midseason varieties mentioned are recommended for western North Dakota and for northeastern Montana.

[1] The Golden Rain is a yellow midseason variety.

The early varieties, Sixty-Day and Kherson, are recommended for western South Dakota and the drier portions of eastern Montana and southwestern North Dakota. Heads of several representative varieties of oats are shown in figure 7.

The early yellow varieties, Sixty-Day and Kherson,[1] are very similar. Both have short, fine straw, suitable for hay, and small, thin-hulled, slender kernels. The midseason varieties have taller, coarser straw and larger, plumper grains, with usually a higher weight per bushel.

Early seeding is best with oats as well as with spring wheat. Sow as soon after sowing spring wheat as a good seed bed can be prepared.

Experiments with different rates of seeding oats have not shown much difference in average yields. Midseason varieties in North Dakota should be sown at the rate of about 6 pecks per acre. In South Dakota and Montana the early, small-kerneled varieties may be sown thinner with as good results. Sow from 2 to 3 inches deep.

BARLEY.

The acreage of barley is increasing rapidly in western North Dakota and eastern Montana. Barley is a good feed crop for all classes of farm animals and should be grown more generally. At Williston and Dickinson the 9-year average yield of the Hannchen barley has been equal in feeding value per acre to that of the best varieties of oats. At Newell it has yielded somewhat less than oats.

Barley varieties are separated into two main groups, two-rowed and six-rowed. The two-rowed varieties yield better than the six-rowed ones in the section under discussion. The Hannchen has yielded well at all three stations. The White Smyrna has yielded slightly more than the Hannchen at Newell and in Montana. Both Hannchen and White Smyrna are two-rowed, bearded, hulled varieties. Part of the beards of both varieties fall off when the heads are ripe. At Williston the six-rowed, hulled variety, Williston No. 170, a strain of Manchuria, has yielded about the same as Hannchen in the last four years (1913 to 1916). At Dickinson the 9-year average yield of Svanhals, a two-rowed, hulled variety, is the same as that of the Hannchen. The Hannchen is recommended for western North Dakota and the White Smyrna for western South Dakota and eastern Montana. The White Smyrna is a short-strawed variety which ripens early and thus often avoids injury from drought. In dry seasons it is sometimes difficult to harvest because of the short

[1] For a more complete discussion of these varieties, see Warburton, C. W., Sixty-Day and Kherson oats, U. S. Dept. Agr., Farmers' Bul. 395, 27 p., 5 fig. 1910.

straw, though early-sown White Smyrna barley is usually tall enough to harvest without difficulty.

At Dickinson the best variety of six-rowed barley is Gatami, an early, black variety. At Newell the Odessa is the best six-rowed variety. Neither of these has yielded as well as the two-rowed varieties. The naked (hull-less) varieties have not yielded well at any of the three stations and are not recommended. Heads of representative varieties of several groups of barley are shown in figure 8.

The highest yields of barley have been obtained from early seeding, as shown by experiments at Williston. Barley ripens more quickly

FIG. 8.—Representative heads of different types of barley; White Smyrna (1) and Hannchen (2), 2-rowed hulled varieties; Coast (3) and Mariout (4), 6-rowed hulled varieties; Nepal (5) and Himalaya (6), 6-rowed naked varieties.

than wheat or oats and may be safely sown later than the other grains if desired.

Rate-of-seeding tests at Williston and Dickinson indicate that barley may be sown at rates varying from 4 to 8 pecks per acre without much difference in the average yields obtained. Results vary with different seasons. In general, the sowing of about 6 pecks per acre is recommended. In dry seasons or in dry districts thinner seeding may give better results.

FLAX.

Flax is an important crop for the new settler because of the success with which it may be grown on newly broken sod, the ready market for it, and its high price in proportion to its bulk. It also gives good returns on old land following any other grain or grass crop or after corn or potatoes. If grown continuously on the same land flax often becomes infected with disease, and weeds become troublesome. To avoid possible loss from these sources it should be included in a rotation in which it is grown on the same land only once in six or eight years.

Flax should have a firm, smooth seed bed. If sown in loose, dry soil or rough, cloddy land the plants will not come up uniformly and the stand will be uneven or thin, giving the weeds a chance to grow. On rough land some of the plants will not be cut by the binder, and this will cause considerable loss.

FIG. 8.—A 320-acre field of North Dakota Resistant No. 52 flax on breaking, 15 miles south of Mandan, N. Dak. The average yield of this field was 15.1 bushels per acre.

Flax is a poor weed fighter and should not be grown on land infested with weeds. The seed should be bright and plump and free from disease and weed seeds. Use the formaldehyde treatment for the prevention of disease, applying the solution as a fine spray. Stir the seed frequently to prevent it from getting too wet and sticking together.

Several varieties of the Russian seed-flax type have given good results in the region discussed in this bulletin. The best of these are North Dakota No. 155, North Dakota Resistant No. 52, and Select Russian (N. Dak. No. 1215). A field of North Dakota Resistant No. 52 flax is shown in figure 9.

Flax sown as early as May 1 usually yields better than that sown later. Flax will stand considerable freezing when it is well up, but is injured by freezing when the plants are just emerging. Late-sown flax ripens very slowly and often is injured by fall frosts. Flax sown

early in June sometimes yields well, but the danger from frost in the fall is greater than in the spring.

The usual rate of seeding flax is about 2 pecks per acre. Rate-of-seeding tests have given somewhat different results for different seasons and localities. If the stand is too thin, the crop ripens unevenly and weeds have a better chance to grow. Generally from 20 to 30 pounds per acre should be sown on a well-prepared seed bed. Flax seed should be covered to a depth of 1 to 1½ inches. If covered to a greater depth the young plants may have some difficulty in reaching the surface.

MILLET.

Proso millet, known also as broom-corn millet or hog millet, is not grown very extensively in western North and South Dakota. Usually it produces less grain per acre than wheat, oats, or barley. It can be seeded in June after it is too late to sow other grains and therefore is of some value as a catch crop to be sown where other crops have failed or when it is too late to sow other grains. The best varieties of proso are Tambov, Orenburg, and Black Voronezh. The Kursk, a small, red-seeded, early variety of common or foxtail millet, has yielded nearly as well as the prosos. Millet is a rather tender crop and should not be sown until the danger of frost is over. When grown for seed, millet should be sown at the rate of about 2 pecks per acre.

RECOMMENDED VARIETIES OF SMALL GRAINS.

For western North Dakota and northeastern Montana, the following varieties are recommended:

Spring wheat: Kubanka durum, Marquis, Power Fife.
Oats: Abundance, Early Mountain, Lincoln.
Barley: Hannchen, Svanhals, Manchuria.
Rye: North Dakota No. 959.
Flax: North Dakota No. 155, North Dakota Resistant No. 52, Select Russian.

For western South Dakota and southeastern Montana, the following varieties are recommended:

Winter wheat (in the vicinity of the Black Hills): Kharkof, Turkey.
Spring wheat: Kubanka durum, Marquis.
Oats: Kherson, Sixty-Day.
Barley: White Smyrna, Hannchen, Odessa.
Rye: North Dakota No. 959, Swedish.
Flax: North Dakota No. 155, Select Russian, North Dakota Resistant No. 52.

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